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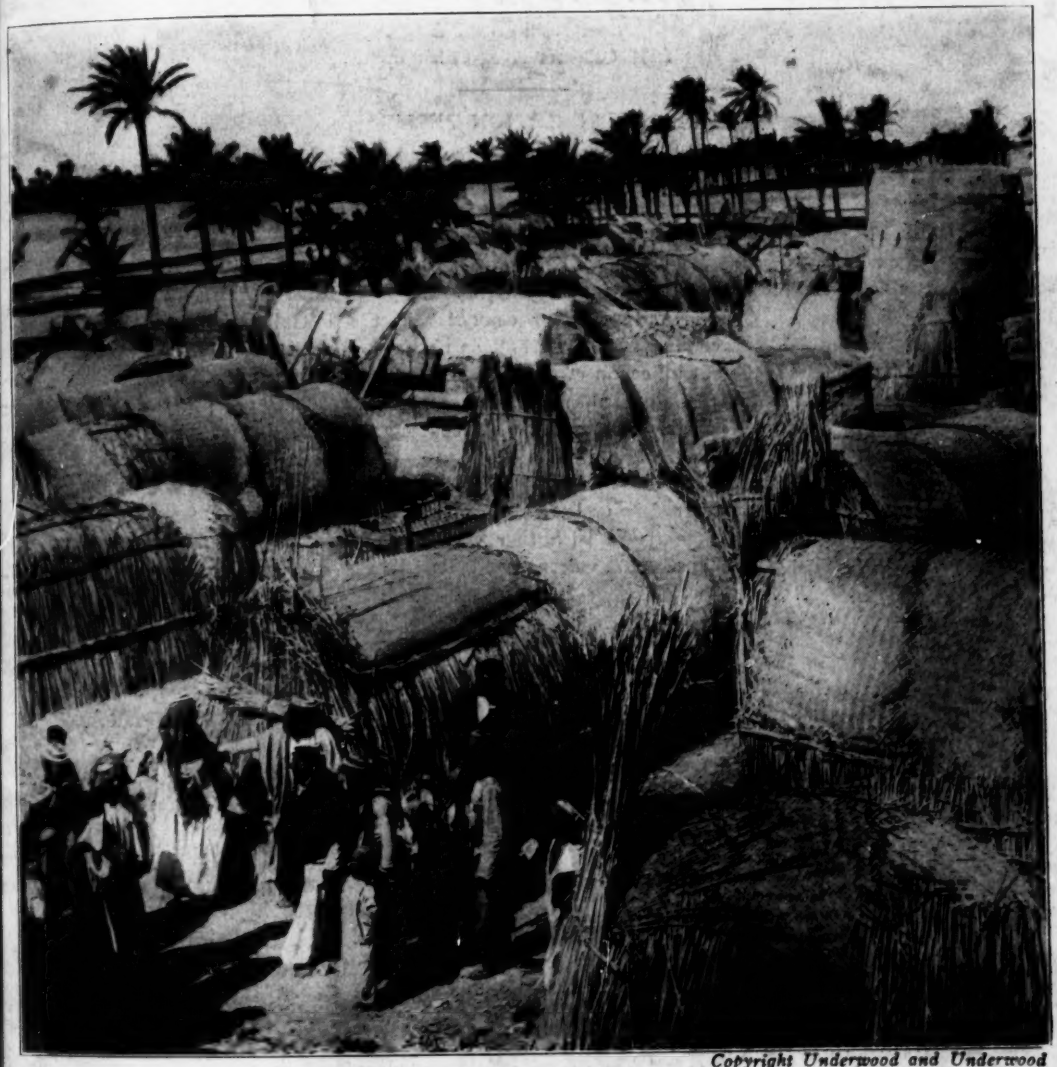

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THE RESOURCES OF HONDURAS

NELS A. BENGTSON
The University of Nebraska

INTRODUCTION

Honduras is referred to by many as the *land of the banana*, while others call it the land of *mañana* (tomorrow). There is truth in both versions, because Honduras is now the foremost banana exporting country in the world and it is also a country of great resources—resources awaiting the development which is to come "mañana."

Perhaps, with many, interest in Honduras may be chiefly from the standpoint of trade. That country exports from 12 to 14 million bunches of bananas annually, most of which are sent to the United States. It also furnishes us large quantities of sugar, coconuts, silver and hides. And their imports are of the types that we can furnish advantageously, the leading lines being cotton manufactures, iron, steel and electrical goods, breadstuffs, boots and shoes, and meats. During the past decade the annual value of imports has averaged about $12.50 per capita for Honduras as compared with $4.80 for Guatemala, $8.90 for Nicaragua, and about $6.00 for Salvador, all of them bordering republics. About 90 per cent of the total foreign trade of Honduras is with the United States.

UNDEVELOPED RESOURCES

Resources awaiting development in this too little known republic typify another source of interest and hence a brief statement may aid in bringing the whole problem before us. These undeveloped resources may be summarized under three groups, viz., timber, agricultural lands, and minerals.

Timber Lands. Nearly all of Honduras is forest covered, but the density varies greatly. In the interior are limited plains areas

with very little timber, while the mountain slopes vary from open pine stands midst heavy grass growth to jungles of mixed tropical hardwoods, brush and vine. In the lower lands of northeastern Honduras it is claimed that there are from 30 to 50 valuable kinds of woods, and conservative estimates have placed the value of the standing timber within a mile of one river and its principal tributaries at over $75,000,000. In the same area it is estimated that there are about 500,000 acres of pine and oak lands which would average at least 14,000 board feet per acre with a probable value of at least $4 per thousand. These timber resources are available along or near water courses and can all be reached by either rail or water transportation, without serious difficulty.

Agricultural Lands. Accurate data regarding agricultural lands are not available, but enough is known to assure us that great expansion is possible. The heavy cover of nutritious grasses on hills and over mountain slopelands give assurance of the possibilities of grazing. Cattle ticks—"garapatas"—are numerous and can only be held in check by large-scale cooperation, a goal not even approached now, and hence presents a discouraging problem to the pioneering individual. For the present the garapata menace and the lack of available markets appear to place livestock development into the future, just how remotely can hardly be forecasted. Nevertheless we are confident that grassy lands, where only two to four acres are needed to support an animal, located where climatic conditions are very moderate, and only four or five days' travel from American ports must sooner or later be brought into production and hence become of increasing value. There are also numerous tracts of land, some of them quite large, suitable for crop production and which are now unused because of lack of available markets for their products.

Minerals. There is great mineral wealth in Honduras. Gold has been washed from the north coast streams since time immemorial, and even now furnishes a steady tho modest source of income to the patient Indians who are panning the stream gravels and sands with the same types of crude utensils used four centuries ago. Samples of gold, reliably collected and assayed, have shown values ranging from $9 to $2,000 per ton for veins which appear extensive enough to justify working on a large scale. Silver, lead, zinc, and copper deposits have been reported altho the extent has not in many cases been determined. Two large silver

mines are in operation despite lack of railroads, and the bar-silver has to be transported from mine to seaboard for part of the journey on mule-back. The great handicap to overcome if development is to be accelerated is the lack of transportation facilities.

This is a summary picture of some of the undeveloped resources of Honduras, based upon the writer's own experiences in the country and upon reports from sources considered worthy of confidence. It challenges attention to some of the features of the country which serve as a geographic background for its present industrial position.

LOCATION, AREA, AND POPULATION

Honduras lies in approximately 13° to 17° north latitude and between the meridians of 83° 15′ and 89° 30′ west longitude. It is due south of Illinois and Indiana and in the same latitude as Cape Verde, Aden, Madras, and Manila. Its north coast is reached in about four days from New Orleans by means of the fruit steamers which make direct trips to the ports of Honduras.

In point of size, 46,250 square miles, it ranks third among the Central American republics, being exceeded only by Nicaragua and Guatemala. Its area is just slightly larger than that of the state of Pennsylvania. Its north coast, nearly 375 miles long, is washed by the Caribbean Sea, while its south coast, only about 70 miles in extent, is made up of the Bay of Fonseca.

The population is estimated to be about 662,000, about 14.3 per square mile. The even more sparsely populated republics of Central America are Panama, 13.4 per square mile and Nicaragua 12.9 per square mile, while Salvador is by far the most densely peopled, 116 per square mile.

TOPOGRAPHIC REGIONS

Honduras has three topographic subdivisions of major importance, namely: the Caribbean Coastal Plain, the Sierra Region of plateaus, mountains and valleys, and the Pacific Coastal Plain. Of these, the Sierra Region is the most extensive, comprising nearly 90 per cent of the entire area of the country.

The Caribbean Coastal Plain from the Guatemalan border eastward to beyond the mouth of Black River, a distance of 275 miles, is but a narrow strip of lowland fringing the mountain front.

Thruout this stretch the mountains rise abruptly from the sea to altitudes of from 1,500 to 5,000 feet. The narrow plain from the foot of the mountains to the seashore is made up of the outwash of silts, sands and gravels. In some places it is less than a mile wide, but for the most of the distance it varies from 3 to 15 miles. Along the larger rivers emptying into the Carribean, broad alluvial plains merge with the coastal plain proper and thus give rise to low-lying fertile lands which permit the coastal climatic conditions to be carried relatively far into the interior. The geographical importance of these alluvial lands as features of the coastal plain is evidenced in the fact that they contribute largely toward making this region the seat of the greatest industry of the country, that of banana production, and have made it possible for Honduras to become the foremost source of banana imports to the United States.

FIG. 1. The banana plant as it appears on the plantations. Two young bunches of fruit are shown with the bananas pointing upward.

The Sierra Region, which comprises by far the greater part of the republic of Honduras, consists of short mountain ranges, separated by deep structural basins into which canyon-like valleys and intricately ramifying tributary systems have been incised. The highest altitudes, exceeding 8,000 feet, are reached in the San Juancito Mountains north of Tegucigalpa.

These are part of what may be termed the Southern Cordilleras, which constitutes the chain of great ruggedness and which connects with the high mountain areas toward Nicaragua on the one side and Guatemala on the other. Along the north coast is a series of ranges known as the Sierra de Omoa, Sierra Pijas, and Sierra Payas, which should be classified together because of their topographical continuity and hence may be termed the Northern Cordilleras. Between the two major groups of mountains thus named are several important transverse ranges which cause the whole interior to be a region of great relief. The popular statement that Honduras is the most mountainous of the Central American countries is not far from the truth.

In many districts, however, particularly those of northeastern Honduras, in the province of Olancho and the territory of Mosquitia, there are relatively large areas of valley lands and gently sloping foothill sections which could be brought under cultivation if markets for the products were accessible. Some of the most prominent of the high-lying interior plains are found in the vicinity of Comayagua, Talanga, Juticalpa, and Palmyra. These plains, lying at altitudes from 2,000 to 2,300 feet, are for the most part open, level tracts with a scanty desert type of vegetation. As may be inferred, they are regions of comparatively low rainfall due to the fact that they are nearly surrounded by mountain ranges which rise from 2,000 to 3,000 feet above them. The average annual precipitation is claimed to be from 30 to 50 inches and sufficient to raise one crop a year successfully, altho several months of each year, February to May, are nearly rainless. As a whole, the Sierra Region of Honduras is noted for its scenic beauty. Its rugged mountains, covered with open forest interspersed with well grassed slopes, rise abruptly from terrace plains or from deep cut canyons, and present vistas of appealing grandeur never to be forgotten by those fortunate enough to observe them.

The Pacific Coastal Plain consists of a relatively small area bordering the Bay of Fonseca. That subsidence, probably in late geologic times, gave rise to the Bay of Fonseca is indicated by the broad estuaries of the streams and by the extensive embayments which project into the coastal plain. These estuaries and embayments are bordered by tidal marshes and mangrove jungles. The islands in the Bay of Fonseca and the mountains which rise abruptly from the coastal plain are largely of volcanic origin,

members of the same general group which extends from Guatemala across southern Salvador, and thru Honduras into Nicaragua. None are active in Honduras, but across the bay in Salvador, smoke may frequently be seen issuing from one or two well-known craters, reminding the observer that he is in the land where earth's fires are still smoldering.

Climate

The Caribbean Coastal Plain has a very heavy rainfall, the lowest being about 100 inches in the western section, while eastward along the Mosquitia Coast it is claimed to exceed 120 inches per year. The coast-facing mountain slopes have a very heavy rainfall and are cloud covered a good deal of the time.

Altho much rain falls annually along the north coast, there is great variation from year to year. Instances have been quoted where the rainfall in one year would be 50 to 60 inches less than was the case in the year previous. This great variation is true not only annually, but also is characteristic of the distribution thru the months of the year. For example, in the district near Tela 43.10 inches of rain fell in January, 1915, while only 4.17 inches fell during the same month the following year. November, 1917, had a record of 34.75 inches, while November, 1919, only had 3.88 inches. This seasonal and annual variation of rainfall gives rise to problems incident both to flood and drought and is thus directly related to agricultural development. The large fruit companies have been compelled to give careful attention to the engineering problems involved in devising adequate surface drainage, without giving rise to too rapid subsurface drainage. The extra hazard to which commercial fruit production is thus subjected is one for which the consumer in this country or in Europe helps to pay whenever he makes his purchase of tropical delicacies, the most important of which is the banana. In the interior the rains are not so heavy nor the rainy season so long as in the coastal regions. The rains usually begin the latter part of April and then are likely to occur at any time until November. During the months from December to March but little rain falls, altho there is considerable variation with altitude and exposure. The long and intense dry season which prevails in the interior plains presents a unique problem in the development of successful agriculture. The most

dependable estimates available place the annual rainfall there at from 30 to 50 inches, practically all of it occurring during six or seven months of the year. Because of the severe conditions brought about by the intense dry seasons these plains now support but a very scanty population, altho some of them at least present a pleasing aspect of tropical vegetation during the wet season and then give promise of large possibilities of production.

Along the Pacific coast the rainy season lasts from May to October inclusive, altho some rain also falls during April and November. December to March are almost rainless.

Temperatures are always moderate. Records quoted by the fruit companies in the vicinity of Tela show that the annual daytime temperature is about 79° F. with known extremes of 56° and 98° F. respectively. June and July are considered to be the hottest months during which time temperatures of 90° to 95° F. are not infrequent between the hours of 10:30 A. M. and 2:30 P. M. Evenings and nights are always moderately cool, due to the sea breezes. These conditions are considered typical for the north coast region. In the interior somewhat greater extremes prevail, but no excessively hot temperatures are encountered and frost is unknown below 6,000 feet altitude.

The winds are generally very moderate, a fundamental influence in banana production, because severe wind storms are especially disastrous to this industry.

Notwithstanding its heavy rainfall, Honduras is a land of sunshine. The rains come as heavy showers in the afternoons or nights and are followed by clearing skies and brilliant sunshine. Protracted periods of cloudiness seldom occur, altho during the rainy season the humidity is very high and the landscape seems to fairly reek with moisture.

VEGETATION

Most of the country is covered with heavy vegetation of some sort. The coastal regions and valleys are jungle covered, except where man has made clearings for fruit farms or for small homes. The slopes facing the Caribbean have a dense growth of deciduous trees, while most of the mountain ridges of the interior are pine-covered. Along the main route of travel across the country from Puerto Cortes thru Tegucigalpa to the Pacific coast much of the

valuable timber has been cut, but farther from the main highways there are large quantities of timber ready for the ax. The pine, which is very abundant thruout nearly all of the interior of Honduras is mostly the long-needle type of yellow pitch pine, which grows remarkably straight, and with a very smooth trunk. There is also a small quantity of white pine, quite soft and of high value for building purposes. In many places there are good stands of oak, which, at present, are not being used to any appreciable extent. The pines and oaks of the interior have but little value at present, because of lack of transportation facilities to place them available at either domestic or foreign markets. Hardwoods, cedars and dye-woods are plentiful in the lower lands, together with a large variety of soft woods of which no use is being made at the present time. The mahogany has mostly been cut along the larger stream courses but farther away from the main streams there are large quantities reported ready for cutting.

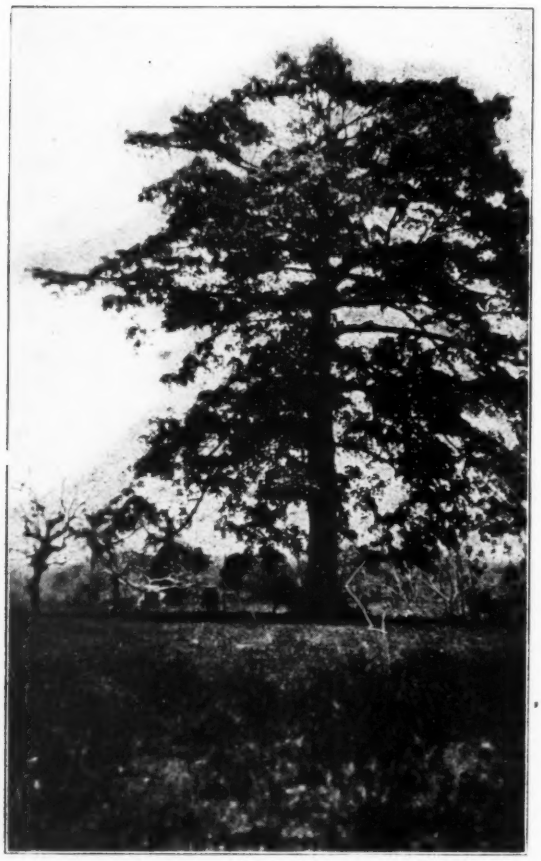

Fig. 2. The Ceiba tree is dominant as to height in many parts of the lowland forest. This tree yields a fiber of high quality for the manufacture of palm beach cloth.

Grazing Conditions

The hilly sections of the interior valleys and the lower mountain slopes are all heavily grass covered. It has been estimated by some livestock investigaters that large areas in northeast Hon-

duras are capable of supporting one animal on every four acres, if conducted purely on a grazing basis. The livestock industry has not made any important advance because of two fundamental difficulties—lack of markets for the meat products, and because of the prevalence of the "garapata," a cattle tick which is found in abundance in practically all parts of Honduras. Lack of markets is due primarily to the absence of transportation facilities. The tick difficulty is being combatted by burning the grass in the dry season, a method which is fairly effective, but, of course, wasteful. It is believed that the tick could be controlled by an intelligent enforcement of modern dipping methods. If this were accomplished, it would be possible to make fuller use of the grazing advantages and to increase tremendously the cattle population of the area provided a system of marketing meat products could be worked out. This, of course, depends on the development of transportation systems and furnishing means of storage for meat products. As far as climate and grazing conditions are concerned, most of the interior of Honduras presents exceptional advantages for the development of a profitable livestock industry.

AGRICULTURAL LANDS

The agricultural lands may be grouped into three broad subdivisions based on location. The coastal plain has a high percentage of land very valuable for tropical fruits, especially coconuts and bananas, and when placed under cultivation is capable of yielding almost phenomenal returns. The production of bananas has trebled since 1910, and in 1922, 14,584,674 bunches were exported to the United States, thus furnishing nearly one-third of our entire supply. The importance of this industry to Honduras is shown by the fact that in 1922 the value of the bananas exported represented 67 per cent of the total exports of the country.

Sugar cane is another crop of increasing importance in the coastal plains area. In the interior are valley bottoms and bench lands adapted to the production of sugar cane, rice, grain crops and tropical fruits. The mountain slopes have lands that are adapted to the cultivation of grain crops, and it seems safe to assert that large tracts of such lands could be made to produce very high grade coffee. Development of the coffee industry of Honduras has been retarded by lack of transportation facilities. Tobacco of high quality is being produced in the uplands of the

interior and seems to furnish evidence that this industry could be developed to a high degree and very profitably, provided modern methods of curing were inaugurated and marketing facilities provided.

MINERAL RESOURCES

Honduras has long been famous for its mineral wealth, but development has been handicapped by lack of modern means of transportation and, as far as the natives are concerned, by lack of capital and a scientific knowledge of modern mining methods. Mineralized zones carrying gold and silver are found in most of the departments of the upland country. Silver mining on a large scale has been developed at San Juancito and Sabana Grande. The silver mines at these two places are being operated with profit in spite of the transportation difficulties that have to be met. In the vicinity of San Antonio, Danli and Yuscaran, a number of silver-bearing deposits are known, but development has not been found profitable so far because of the difficulty of transporting supplies and fuel. The gold deposits, both of vein and placer type, of the Jalan and Guayape valleys are apparently very extensive and some of them probably represent large ore bodies. The natives are working in a number of places on a small scale and in a most primitive way and, while their rewards are not large, they may be deemed very successful in view of the methods used. Gold has been found in most of the stream gravels of the uplands of eastern Honduras and in many of the valleys along the northern coast. This condition indicates a probability that careful prospecting will reveal gold bearing veins of such quality that they can be mined profitably if transportation can be furnished that will be more efficient than the present slow and expensive mule-back freighting.

In addition to the minerals named, there are deposits of iron, lead, zinc, and copper ores and, while their extent has not been proven, they constitute a resource of potential value. Under present conditions there is but little inducement to attempt to exploit any of the mineral wealth because of the difficulty and expense of obtaining supplies and marketing the products.

WATER POWER

There is to date very little water power development in Honduras. The electric light plants in most of the cities are operated

by fuel oil as are also the mines and mills at Sabana Grande. At San Juancito, however, a successful hydroelectric plant is in operation. The principal obstacles to water power development are, (1) the uneven flow of the streams thru the year, varying from almost dry beds in the latter part of the dry season, to raging floods in the height of the rainy season; (2) the absence of lakes which would serve as reservoirs to equalize the flow; (3) lack of market for the current produced. The third is, after all, the controlling factor because the streams are swift and dam sites are numerous so power could be provided if the economic pressure were sufficient to demand its installation. Abundance of rainfall and lack of winter freezing troubles would go far to counterbalance the uneven distribution of rainfall thru the seasons.

Water Supplies

The heavy precipitation and rugged topography combine to give the country an abundance of mountain streams of good water in all departments. There are very few wells in Honduras. People nearly everywhere depend on the streams for their water supplies. The stream water seems warm to the northern palate and there is, therefore, a tendency to condemn it, but the water itself is not bad so that if ordinary sanitary precautions were taken to safeguard the streams from pollution, it would not be dangerous. The natives have little conception of the need of sanitation, hence they bathe and wash their dirty clothes in the streams at the same places where they obtain their drinking water and pay very little attention to the pollution involved. It is no uncommon sight to find villagers taking drinking water out of streams nearby where others may be bathing or washing. This practice accounts for much of the sickness which is often blamed against an unhealthful climate.

Industrial Development

Except where touched by foreign, chiefly American, capital and energy, there is but little industrial activity in Honduras. The people are to a very large extent self-supporting, but their needs are not great. The principal exports of the country are bananas, coconuts, coffee, gold and silver, cattle, hides, tobacco and mahogany. Among these, bananas hold first rank by a wide margin. The banana industry has assumed gigantic proportions along the north

coast because American genius and capital have come in to direct native labor in making the best use of the very favorable climatic and soil conditions there existing. Three large companies are now sending ten to twelve shiploads of bananas to the United States every week. The activities of these concerns have developed the north coast region until one can hardly believe that it is a part of Honduras. The general business tone is one of hustle and energy and not the spirit of lassitude generally encountered in the interior.

Altho Honduras is well forested there are but few sawmills and very little lumber manufacture. Small sawmills are located on the plateau north of Tegucigalpa—near Comayagua and Siguatepeque—and larger ones at the north coast towns. The interior towns depend on hand sawing for their lumber and in many places a board is a scarce commodity. Some lumber is imported each year from the United States.

Formerly there was much mahogany obtained in Honduras, but during late years this industry has greatly dwindled. The reasons for the decline are twofold, scarcity of labor and increasing difficulty of obtaining the mahogany because the supplies near the easily accessible water courses have been cut.

HOUSING

The warm climate renders unnecessary the heavily built houses found in the high latitudes. The houses are usually one or two room affairs, chiefly constructed of adobe, staves or monaco leaves and have earth floors. The adobe houses are prevalent in the high sections of the interior where the temperatures are lower and where the winds are sometimes quite chilly. In the lower altitudes where the temperatures average high, the houses generally have walls made of staves or poles set upright and with thatched roofs. This type of house is well adapted to the climatic conditions, for it furnishes protection from sun and rain and is well ventilated and hence makes quite a comfortable home.

From an industrial standpoint, providing houses for laborers is neither difficult nor expensive. If frame houses are desired, the lumber can be made from the timber within easy reach of any part of the country, and if the native types are preferred, the materials for their construction are everywhere at hand. The cost of building is comparatively slight, because of the simplicity of design and

FIG. 3. Cathedral and business buildings of Siguatepeque, on the plateau of the Sierra region. Note the solid walled buildings as a response to climate where nights are very cool

FIG. 4. A typical native home in the interior lowlands where days and nights are always warm

the small amount of labor and material needed to build according to the customs of the country.

Sanitation and Disease

The great mass of the natives know nothing of the importance of sanitation. Thru the efforts of the fruit companies and of the Rockefeller Foundation working in cooperation with the government, the coastal regions have, however, been cleaned up so that they are free from the ravages of Yellow Fever and other dreaded

Fig. 5. Modern screened and well ventilated buildings are characteristic of the permanent quarters provided by the large fruit companies for their employees.

tropical diseases. The climate is, on the whole, delightful and there appears no reason why the diseases which have given a bad reputation to the region could not be wiped out if proper sanitary measures were enforced. The fruit companies have not found health conditions a menace when such measures have been put into operation. These companies have changed a region, formerly considered by the natives as well as by the whites a belt reeking with tropical fevers—a veritable death zone—to one where northerners and natives alike, may live without fear of disease. The success attending the sanitary camps of the fruit companies points the way clearly for other industrial enterprises as far as sanitation and disease are concerned.

CONCLUSION

In conclusion it may well be repeated that Honduras is a country of large resources awaiting development. The great need is that of modern means of transportation. The problems of road-building—auto highways and railroads—are difficult because of the ruggedness of much of the interior, but they are not insurmountable. Much more difficult conditions have been overcome elsewhere. The enervating influence of the climate has been unduly emphasized, and much of the so-called tropical laziness is due to disease rather than to an inevitably depressing climatic influence. Sick folks are not usually energetic whether they live in Honduras or in Canada. With the inevitable advances in road construction and with improved sanitary conditions which economic pressure and a progressive medical science will bring, the potential resources of Honduras, its timber, soil, and mineral wealth, will become active forces in industrial progress. It may then truly be said that it is the land of *mañana*, and "tomorrow" will mean a new day for Honduras.

SOME EFFECTS OF TROPICAL CYCLONES

STEPHEN S. VISHER
Indiana University

Tropical cyclones, often called hurricanes or typhoons, occasionally produce great destruction and loss of life. The Galveston, Texas, hurricane of 1900, which resulted in a loss of 6,000 lives and damage to property estimated at over $30,000,000 was far surpassed by the Swatow, China, typhoon of August, 1922, which caused over 30,000 deaths and enormous property loss. But the typhoon which reached Yokohama and Tokio just after the terrible earthquake of September, 1923, was yet more disastrous. According to Doctor T. A. Jaggar, volcanologist of the United States Weather Bureau, who investigated the catastrophe by the invitation of the Japanese Government, more than 100,000 deaths and over a billion dollars worth of property loss were certainly caused by the typhoon winds which quickly spread the fire and drove it upon huddled multitudes.

Fortunately such severe damage is rare, but tropical cyclones are far more frequent and widespread than is commonly realized

(See Fig. 1) and even the lesser storms usually do considerable damage. Only by knowing of the danger and by adjusting ourselves to the storms can we avoid repeated heavy losses. The Galveston disaster led that city to protect itself from similar storms by building a great sea-wall, and by raising the level of the lower parts of the city. These efforts were so successful that a recent hurricane of even greater severity caused comparatively little damage. Likewise, partly because of the Galveston disaster, our government now maintains an efficient meteorological service thruout the West Indies so that as soon as a hurricane develops, or approaches the area from the east, its special characteristics can be studied, and warnings issued. In the Far East likewise the American government has reduced the damage from tropical hurricanes,

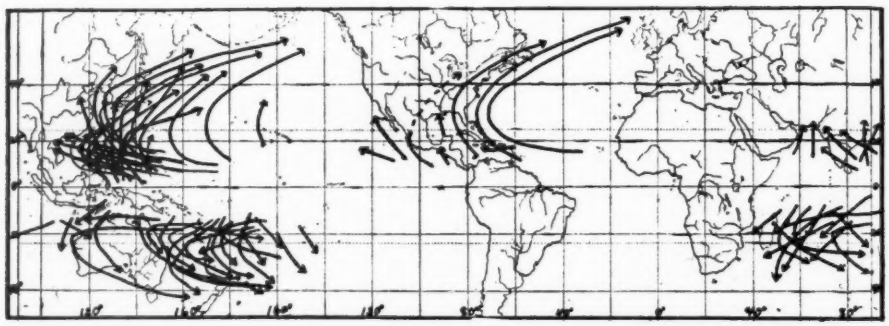

FIG. 1—Sketch map showing tracks of the tropical cyclones (hurricanes, typhoons, and gale-producing cyclones) of an average year. (Original)

there called typhoons, by its share in developing the now splendid Philippine Weather Bureau.

Tropical cyclones are great whirls of air, comparable to the less intense cyclones or "Lows" of mid-latitudes, but usually smaller and more intense. By imagining a dust whirlwind magnified until its diameter is more than 100 miles, one can obtain some idea of tropical cyclones. They resemble a tornado in the strength of the in-whirling winds, in the irregularity of their movement and in being most frequent in one season. They differ from tornadoes, however, in several respects. Altho tornadoes are seldom destructive over a belt wider than a quarter of a mile or longer than thirty miles, tropical hurricanes may cause great damages thruout a belt a few hundred miles wide and a few thousand miles long. But, on the other hand, the wind is nowhere as strong as within a typical tornado. As to season of occurrence, altho

tornadoes are most frequent in spring and early summer, tropical cyclones most often occur in late summer and autumn.

It was the writer's good fortune to be sent by Yale University, the Bishop Museum of Honolulu and Indiana University, to study the tropical cyclones of the Pacific. Many islands were visited, as well as Australia, China, and Japan. This article is chiefly a summary of certain chapters of a monograph being published by the Bishop Museum.

DAMAGE DONE BY TROPICAL CYCLONES: THE WIND

Tropical cyclones cause damage in several ways. The violent winds break off many branches of trees, tear off the roofs of many

FIG. 2—Effects of typhoon winds upon houses in the city of Cebu, Philippine Islands

buildings or demolish the entire house, if it is not strongly built (Fig. 2). Flying branches, timbers and pieces of sheet-iron roofing in towns often increase the destructiveness of the wind. Upon the sea, the hurricane not infrequently disables ships, sometimes causing them to flounder, or blows them upon the shore (Fig. 5). Two characteristics of the wind increases the damage it does. The first is its notable gustiness; instead of blowing steadily at a given velocity, it varies in strength very suddenly, taking by surprise, as it were, objects endeavoring to withstand it. The calm at the storm's center is the most extreme illustration of the radical change in the strength of the wind. Often "the eye of the storm" the calm is so complete that a match may be kept lighted in the

open, where a few minutes before a hurricane of eighty or a hundred miles an hour raged. But the calm is usually of short duration, and the wind comes up with its previous violence within a short time.

The second special characteristic of the wind which increases its destructiveness is the change in direction. Near the storm's center the wind changes direction completely, shifting by jerks thruout half the points of the compass. Indeed, where secondary centers occur, the winds may "box the compass" more than once. The most sudden, complete change of direction occurs where the central calm or "eye of the storm" passes, because the wind blows in opposite directions on opposite sides of the center. In addition to the systematic changes in wind direction related to the cyclonic circulation about the center, there are innumerable irregular changes of direction related to temporary eddies such as those caused by obstructions. Successive gusts nearly always come from slightly different directions and conspicuous irregular changes of direction are frequent.

The strong winds not only damage structures reared by man, but they seriously injure vegetation. Often most of the leaves and fruit are stripped from trees, many branches are broken, and numerous trees are broken off or uprooted. Sugar cane is badly injured by being bruised, knocked down and often more or less covered with mud, for many cane fields are located upon the fertile river plains that are flooded by torrential rains. Even the important yam crop, the useful part of which is beneath the ground, is injured by hurricane winds, for the rather rank stems are often broken, and the large leaves torn or bruised.

Wave Damage Along Coasts

The waves break with great fury upon the shore, often demolishing seaside buildings and trees (Fig. 3). Harbors are also injured both by the damage to wharves and docks and by the partial blocking up of the channel by great blocks of coral which have been broken off and transported by the waves, or by wrecked ships or by drifted sand. Masses of coral rock "as large as a house" have been tossed about by hurricane waves.

The elevated sea level produced near the storm's center by the inrolling waves and the partial vacuum greatly increases the destruction along coasts. In case a barometric minimum of twen-

ty eight inches occurs, a local rise of about two feet in the sea level results, increasing the height of the waves, and permitting them to advance much farther upon a shelving shore.

Where the wind blows violently for several hours upon a low, shelving coast, the sea may advance notably upon the land. If a large, flooded, river flows into the sea on such a coast, the combined flood, due to the waves, the partial vacuum, and the river may submerge areas that are normally many feet above sea level. For example, at Nasouri, Fiji, on March 24, 1910, the water level rose thirty-five feet above the normal level of the Reva River,

FIG. 3—Effect of wind and wave upon a strongly built "naval club," Cebu, Philippine Islands

which is here practically at sea level. Waves reached a height of forty-six feet above sea level at Mille, latitude six degrees north in the Marshall Islands on June 30, 1905.

The sudden coming of great waves drowns many people upon low coasts, and along the lower stretches of river valleys. Sometimes, indeed, the water advances as a wall-like wave several feet in height, from which people in its path find escape very difficult. Most of the more than fifty thousand persons destroyed in and near Swatow, China on August 23, 1922, probably lost their lives, by drowning, as the general sea level rose eight feet and great waves rolled over the lowlands. Two of these waves are said to have reached twenty-five feet above normal sea level.

Drowning probably also caused the death of many of the three hundred thousand persons said to have been killed by the Haifong, China, typhoon of October 8, 1881.

Excessive Rainfall

Rain normally falls in torrents during the passage of a tropical cyclone, often several inches in an hour or two, and sometimes 20 inches in a day. Indeed, records of the fall of over 30 inches within twenty-four hours are not lacking. The extreme record so far noted is 46 inches (1,168 mm.) in twenty-four hours at Baguio, a mountain station near Manila in the Philippines, during the passage of a typhoon, July 14-15, 1911. During the four days required for this typhoon to pass, 88 inches (2,238.7 mm.) fell. An even greater amount (96.5 inches) fell on Silver Hill, Jamaica, in

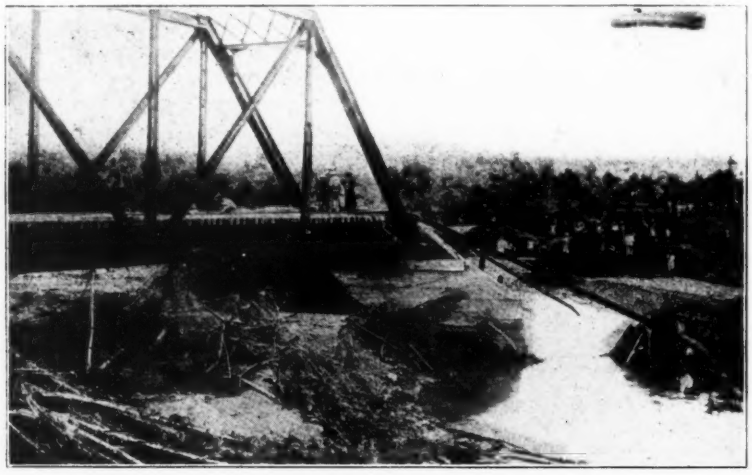

Fig. 4—Effect of the flood caused by a typhoon, upon the approach to the railway bridge near Cebu, Philippine Islands

four days during the passage of a hurricane. In tropical Australia more than 10 inches fell on more than four hundred different days in a twenty-five year period, and a maximum of 35.71 inches in twenty-four hours at Crohamhurst, near Brisbane, Queensland, (Feb. 2, 1893). Sixty inches fell in a three-day period at Mt. Molly, Queensland, and there have been many forty-eight hour periods during the passage of a tropical cyclone when more than 25 inches fell in tropical Australia.

Excessively heavy rainfalls have occurred in other parts of the world also during the passage of a tropical cyclone. For example, at Funkiko, Formosa, in three days, July 18-20, 1913, 81.5 inches (2,071) mm.) fell, and 40 inches (1033 mm.) on one day (Aug. 31, 1911). In the United States most of the excessive widespread

rainfalls have been caused by West Indian hurricanes that have moved northward.

The downpours which often occur during tropical cyclones, besides sometimes causing serious floods, damaging roads, irrigation works and railroads (Fig. 4), frequently erode the soil very badly on even gentle slopes. The heavy rain also influences the amount of uprooting of trees. Certain tropical trees, such as the coconut palm, usually can be bent until the top touches the ground, without breaking or uprooting. However, if the soil has been thoroly soaked by excessive rains, uprooting is much more easily accomplished. The damage caused by the run-off of the torrential rainfall includes all the ordinary sorts due to floods elsewhere. In addition, the occasional suddenness of the rainfall in great amounts sometimes results in torrents sweeping down shallow depressions which in ordinary rains carry no run-off.

DAMAGE TO SHIPS

The "mountainous" waves caused by the hurricane winds are the chief cause of destruction upon the sea and are important along the coasts. The waves cause damage to ships in four principal ways. They dash over the decks, often sweeping away part of the equipment, such as lifeboats, or cargo, if some of it is carried on deck. Sometimes, water enters the boat thru the hatchways or ports, damaging the cargo or interior equipment. The passage of high waves under the boat repeatedly exposes the propellers, causing them to "race" badly. Since the sudden speeding up of the propellers, when they are lifted into the air, and their equally sudden slowing down when they are again covered with water, subjects the machinery and engine to great strains, it is necessary to run the engine at greatly reduced speed, or even to shut down entirely when the waves are especially bad. A third way in which the waves injure ships is by wrenching them badly. Old boats, especially wooden ones, are likely to leak after having been so wrenched. Indeed, more than one ship has been broken in two in the middle by being suspended between two great waves, or by having her ends unsupported. Even the best of steamers are sometimes injured by having their engines and boilers displaced by the violent rolling and pitching of the ship and the shiftings of the cargo. The occasional damage from explosions and from the escape of steam caused by the breaking of steam pipes, is sufficiently great to cargo and boat to be mentioned. Furthermore,

persons in the engine and boiler rooms who know the danger from these sources are not at ease when the waves are very severe. A fourth way in which ships are damaged in hurricane is by running upon the shore (Fig. 5). When, because of the danger or the impossibility of making headway against the storm, the ship is "hove to" and drifting with the storm, the danger of running aground is very great for any ship that is near land.

There is so much loss of life on ships at sea during hurricanes, by washing overboard, by throwing persons against walls or other hard objects, by striking them with displaced equipment or cargo and by drowning with inrushing water, that mention of mere sea-

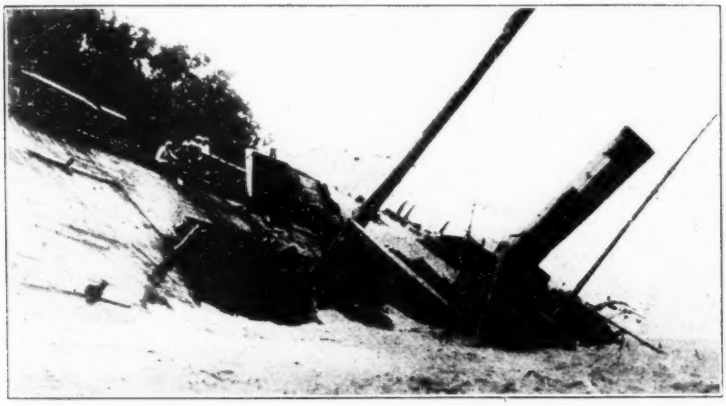

FIG. 5—A small steamboat driven by the typhoon winds and waves upon the shore of Tablas Island, Philippine Islands

sickness seems almost trifling. However, even the very temporary injury of crew and passengers by illness caused by the irregular movement of the ship, is also of some significance. The crew is less efficient, and passengers are less numerous than they would be if such illness did not occur. Indeed, the fear of seasickness is one of the great deterrents to ocean travel. Thus, the rough sea characteristic of even the less severe tropical cyclones injures the ship's business, if not the ship itself. The large premium required by insurance companies because of the danger to ships in tropical cyclones is another way in which the ship's profits are reduced.

TROPICAL CYCLONES ENCOURAGE A WISER DEVELOPMENT OF THE TROPICS

One of the subtle difficulties of tropical development is its apparent ease and simplicity. But in fact it is neither simple nor easy. The occasional hurricanes help make this evident, and put

a premium on forethought, wise planning and skillful management.

The destruction which is often brought about by tropical cyclones encourages the diversification of human activities both on a larger scale and in wider-spread development. Because of the handicaps of the high temperature, frequently erratic rainfall, the many animal and plant pests (including diseases) and the low standard of living of many of the natives, the full utilization of the tropics is very difficult. Apparently a fuller utilization can be most effectively accomplished by the governments or by large and strong companies developing several resources in widespread regions. In other words, hurricanes tend powerfully to discourage any development of the resources of the tropics except such as is carefully considered, undertaken with courage, and carried out with skill and determination. If hurricanes were the only factor in discouraging the use in the tropics of the individualistic and haphazard methods of development characteristic of temperate regions, this fact might not be mentioned as one of their beneficial aspects. They accomplish effectively and quickly what several other aspects of the tropical climates do only slowly but with a greater mortality and greater material loss. They make clear that the tropics have their special problems and can be "conquered" only by those who recognize this clearly, and act accordingly.

POSSIBILITIES OF REDUCING DAMAGE BY TROPICAL CYCLONES

Altho obviously loss of property and life from severe tropical cyclones can not be entirely prevented, it certainly can be greatly reduced. Indeed, it has already been greatly reduced.

Property losses may be reduced in several ways: (1) Buildings should be located so as to avoid tidal waves and floods. Hence they should be at least twenty feet above sea-level or valley-bottom. (2) They should be strongly constructed so as to withstand the wind. Well-built reinforced concrete houses are nearly windproof. Wooden buildings can be made strong enough to resist all but the very worst "blows." It is desirable that a portion of the dwelling be of reinforced concrete, with an independent roof, so that if the remainder of the house, and the main roof are torn away, a haven of safety will remain.

(3) The desirability of considerable diversity of crops and other sources of food and income is evident. Such diversity reduces greatly the severe hardship following a blow. To be sure, the storm may knock off the coconuts, so that none can be harvested

for two or three years, except those which were nearly ripe on the trees at the time of the storm; may break down the bananas so that none may be gathered for a year, and may greatly reduce the yield of sugar cane, bread fruit and mangoes. Nevertheless, with several types of crops, including root crops such as yams and plaintains, it is improbable that all will be seriously injured by a hurricane.

From the standpoint of the white investor in tropical plantations it is desirable that the company have holdings in more than one locality, as it is improbable that all parts of a scattered holding will be seriously damaged during the same year.

(4) The very considerable advantage obtainable from even a day's warning of the approach of a hurricane makes very desirable the maintenance of one or more central weather bureau stations in each of the stormier regions, where the observations received by radio from ships, and by telegraph or telephone from widely scattered secondary land stations can be plotted on a weather map, and the storm's course, speed, size and intensity determined. Such central stations can then send out warnings which often prove of immense value.

Announcement of the approach of a cyclone often enables steps to be taken to effect great reduction in the damage done. For example, in the day or two of grace that is often so obtained, the livestock may be driven from the lowlands and valleys to avoid flood, buildings may be reinforced; valuable personal property may be gathered into safe places, and small boats may be hauled high on shore.

(5) Hurricane damage to certain crops can be decreased. For example, the taller growing variations of bananas are being supplemented in Fiji, Samoa and in various other island groups of the Pacific by the dwarfed Chinese banana because the smaller kind is much less likely to be injured by storms, than are the taller ones.

Sisal, altho its coarse spine-like leaves are very strong, is badly injured by a hurricane. The injury is of a peculiar sort. Few leaves are broken, and the damage is not apparent for a day or two. However, after a few days, the larger leaves turn black and become almost valueless for fiber. Consequently, the larger leaves should be cut during the first day or two after the storm, when they are still in excellent condition.

Rubber trees are subject to two kinds of hurricane damage—the loss of leaves and branches as with other trees, and the more

serious "bleeding" of the rubber latex or sap at every injury. Hence, if a rubber plantation is to be attempted in a storm region, it should be in as protected a valley as possible, and the areas planted to rubber trees should be surrounded by taller trees to afford as much protection as possible from the wind.

(6) The discouragement and individual poverty often caused by destructive storms can be greatly reduced by insurance. Well constructed and carefully located buildings could be insured by a strong company or the government for a rather low premium in most parts of the tropics, for the prospects of the destruction of such buildings is rather small in all but the stormiest areas. Crop insurance against hurricanes should not be prohibitive in expense if all the crops of a large area were insured. But since relatively few people will insure their crops unless the rate is low, and unless almost required to do so, it seems probable that some sort of governmental insurance will be required in the stormier sections of the tropics if they are to be adequately developed. The other alternative appears to be the abandonment of much of the better land to very wealthy companies, such as the United Fruit Company of the West Indian Region, since such companies are enabled by their large sinking funds to carry their own insurance upon their many widely scattered holdings.

(7) Coastal cities may be protected from hurricane waves by the construction of a scientific sea wall, such as that erected by Galveston.

(8) Methods of reducing losses at sea are discussed in mariners' manuals and on the reverse of pilot charts. Briefly, three main objectives should be sought: (a) To keep out of the path of approaching storms, or if that is not accomplished, to keep as far from the center as may be possible, and avoid the "dangerous semicircle" of the storm, namely the side upon which the cyclonic winds are strengthened by the prevailing winds of the region. (b) If involved in the storm, care should be taken to so run or to so drift "hove to" as to work away from the path being followed by the storm, instead of towards it, as will often happen if care is not taken. Indeed, steamers often overtake storms. (c) Various methods of reducing the danger from the waves are known, and should be taken advantage of. One of these is to guide the ship so that the waves strike head on or else stern on. Another is the use of oil to reduce the waves and a third, very important point in case the storm's center passes over the boat, is to prepare for the

abrupt change in wind direction and waves after the calm passes. The carrying out of these main objectives is very greatly facilitated by an accurate knowledge of the location of the storm center, its movements and the size and intensity of the storm. These facts can be learned only imperfectly from observations made by a single observer, but where scattered observers are in communication by radio, data to permit the construction of a map showing the position of the storm's center and its movements may often be quickly gathered. If several scattered ships or land stations report their meteorological observations to a well-manned land station, they can usually receive prompt information, with only a small prospect of error, as to the storm's location, intensity and movements. Near land, the danger from running aground in a storm is so great that ships unable to anchor securely in a relatively safe harbor often put out to sea. Anchored ships often require two or three anchors in a storm, and also the help of the engine to prevent being dashed upon the shore by the in-rolling waves.

ROMANCE AND ADVENTURE OF SCIENTIFIC TRAVEL

A Bibliography

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Introduction

As indicated by the title, this bibliography includes only popular accounts of scientific travel. If more detailed or scientific accounts are wanted, government reports or the various expeditions may be consulted. No magazine articles are given, as many of them duplicate the material which was later published in book form.

United States

King, Clarence. Mountaineering in the Sierra Nevada. 1902. Scribner, $2.35.

"The author possessed the rare qualifications of great daring, enthusiastic appreciation of nature, humor, the trained eye of the scientist and the style of an artist." *Viewpoints in travel.*

Mills, E. A. Wild life in the Rockies. 1909. Houghton, $1.75.

An interesting description of vegetable and animal life in the Rockies.

MUIR, JOHN. A thousand mile walk to the Gulf. 1916. Houghton, $3.25.

POWELL, J. W. First through the Grand Canyon. 1915. Macmillan, $2.

"Record of pioneer exploration of the Colorado River in 1869-70." Sub-title.

PUMPELLY, RAPHAEL. My reminiscences. 1918. Holt, $7.50

Foremost a book of travel. The author has traveled widely, making geological investigations, the foremost explorations in our own country being in the Lake Superior region.

ALASKA

MUIR, JOHN. Travels in Alaska. 1915. Houghton, $3.25.

"Natural wonders described." *A. L. A. Catalog.*

SHELDON, CHARLES. Wilderness of the Upper Yukon. 1911. Scribner, $3.00.

Describes a virtually unexplored region. Of especial value for its observations of animals of the far north.

CANADA

ADAMS, JOSEPH. Ten thousand miles through Canada. 1912. Stokes, $1.50.

Researches into the natural resources and commercial industries of Canada.

CLARKE, J. M. The heart of Gaspe. 1913. Macmillan, $2.

A geologist's description of Gaspe County, part of a peninsula on the Quebec coast.

COLEMAN, A. P. The Canadian Rockies. 1911. Scribner, $3.50.

Description of eight mountain climbing expeditions, to the Canadian Rockies, by a geology professor.

HORNADAY, W. T. Campfires in the Canadian Rockies. 1906. Scribner, $3.

Information on nature, as it exists today, in the Canadian Rockies.

TOWNSEND, C. W. Along the Labrador coast. 1907. Estes, $1.50.

A special study of bird life but also observations on geology, flowers, trees, fish and fishermen and the Eskimos.

MEXICO

HORNADAY, W. T. Campfires on desert and lava. 1908. Scribner, $3.

"Racy narrative of distinguished zoological experiments while exploring a little known region in northwest Mexico. Hunting, geographical knowledge and study of plant and animal life main objects in view." *A. L. A. Catalog.*

LUMHOLTZ, K. S. New Trails in Mexico. 1912. Scribner, $6.00.

"Study of flora and fauna, geography and ethnology, made in Arizona and northern Mexico. Excellent photographic illustrations." *A. L. A. Catalog.*

SOUTH AMERICA

MILLER, L. E. In the wilds of South America. 1918. Scribner, $6.

"Six years of exploration observing little known peoples and animals in strange jungles and mountains. Interesting." *A. L. A. Catalog.*

BEEBE, C. W. Edge of the jungle. 1921. Holt, $2.50.

Deals with the observations of the jungle about the tropical research station of the New York Zoological Society, in British Guiana.

BEEBE, C. W. Jungle peace. 1918. Holt, $1.50.

The interesting account of the author's study, at first hand, of the animal life in the jungles of British Guiana.

BRAZIL

AGASSIZ, LOUIS and AGASSIZ, ELIZABETH C. C. Journey in Brazil. 1895. Houghton, $2.50.

"A fascinating account of nature and man in South Brazil and on the Amazon in 1865 and 1866." *H. R. Mill.*

BATES, H. W. A naturalist on the Amazon. 1910. Dutton, $1.

A record of eleven years spent in the study of the natural history of the region.

LANDOR, A. H. S. Across unknown South America. 1913. 2v. Little, $10.

A scientific record of the unexplored interior of Brazil.

LANGE, ALGOT. In the Amazon jungle. 1912. Putnam, $2.50.

ROOSEVELT, THEODORE. Through the Brazilian wilderness. 1914. Scribner, $3.

"Entertaining description of the hardships and adventures of the Roosevelt-Rondon scientific and hunting expedition." *A. L. A. Catalog.*

PERU

PECK, A. S. Search for the apex of America. 1911. Dodd, $3.50.

"Describes the author's five attempts to climb Huascaron and her final success in reaching an altitude 2500 feet higher than any man residing in the United States had climbed." *Booklist.*

BINGHAM, HIRAM. Inca land. 1922. Houghton, $5.

Exploration searching for traces of the lost civilization of the Incas. Contains a bibliography of the Peruvian expedition of Yale University and the National Geographic Society.

PATAGONIA

HUDSON, W. H. Naturalist in La Plata. 1892. Dutton, $2.

The natural history with especial attention to the birds of the region.

LOOMIS, F. B. Hunting extinct animals in the Patagonian pampas. 1913. Dodd, $1.50.

"A graphic account of the Amherst expedition of 1911." *Booklist.*

SKOTTSBERG, C. J. F. Wilds of Patagonia. 1911. Macmillan, $3.

"Narrative of the Swedish expedition to Patagonia, Tierra del Fuega and the Falkland Islands, 1907-9 . . . . written by the botanist of the party." *Nation.*

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AKELEY, CARL. In darkest Africa. 1923. Doubleday, $5.

The adventures, in Africa, of a naturalist and sculptor.

BRADLEY, MRS. M. (H) On the gorilla trail. 1922. Appleton, $5.

An expedition with Mr. Akeley, a scientist of the Field Columbian Museum, in a search for gorillas.

JOHNSON, M. E. Camera trails in Africa. 1924. Century, $3.50.

Important camera records of the animal life in East Africa.

DRACOPOLI, I. N. Through Jubaland to the Lorian Swamp. 1914. Lippincott, $3.50.

Geographical exploration of a part of Central Africa, little known to Europeans. Scientific appendix.

DU CHAILLU, P. B. Explorations in Equatorial Africa. 1861. Harper.

The results of the research of a naturalist in this rich field for scientific study.

OSWALD, FELIX. Alone in the sleeping sickness country. 1915. Dutton, $4.

"Geology, flora and fauna of the Victoria Nyanza region and manners and customs of the native Negro tribe. Simple and direct with many photographs." *A. L. A. Catalog.*

INDIA

HORNADAY, W. T. Two years in the jungle. 1901. Scribner, $2.50.

Trip of a naturalist in India to collect specimens for the United States National Museum.

HOWARD-BURY, C. K. Mount Everest. 1922. Longmans, $7.50.

Describes the geology, natural history and botany of the region.

CHINA, MONGOLIA AND TIBET

ANDREWS, R. C. Across Mongolian plains. 1921. Appleton, $5.

"A Naturalist's account of China's great northwest." Sub-title.

ANDREWS, R. C. and Y. B. Camps and trails in China. 1918. Appleton, $5.

"The non-technical side of the Asiatic zoological expedition of the American Museum of Natural History in 1916-17." *A. L. A. Catalog.*

CARRUTHERS, A. D. M. Unknown Mongolia. 1914. 2v. Lippincott, $7.

A popular account of the scientific exploration of the little known region about the sources of the Yenesei River.

FARRER, R. J. On the eves of the world. 1917. 2v. Longman's, $9.

An expedition to the Kansu-Tibet border to explore in the interests of horticulture and forestry. Beautifully illustrated.

FARRER, R. J. The rainbow bridge. 1921. Longman's, $7.50.

Experiences of a botanist-author in the remote Kansu Province of China.

HEDIN, S. A. Adventures in Tibet. 1904. Hurst.

A popular edition, based on the author's earlier work, "Central Asia and Tibet."

LANDOR, A. H. S. An explorer's adventures in Tibet. 1910. Harper, $1.50.

"A condensation of "In the forbidden land" intended for young people. *Booklist.*

WARD, F. K. Land of the blue poppy. 1913. Cambridge Univ. Press, $4.

A valuable contribution to the geography, geology and natural history of the little known borderland between western China and southeast Tibet.

CZAPLICKA, M. A. My Siberian year. 1916. Pott, $3.

The account, by a student of anthropology, of a year with an exploring party among the Tartar tribes of the Yenesei River region.

HAVILAND, M. D. A summer on the Yenesei. 1915. Longmans, $3.75.

"Pleasantly recounted adventures of a naturalist who traveled 2,000 miles on the Yenesei, observing bird life on the "tundra," and incidentally, native life." *A. L. A. Catalog.*

AUSTRALIA AND NEW ZEALAND

DU FAUR, FREDA. Conquest of Mount Cook and other climbs. 1915. Scribner, $4.50.

Descriptions of climbs in the New Zealand Mountains, including the writer's own experiences. Beautiful illustrations.

LUMHOLTZ, K. S. Among cannibals. 1889. Scribner, $2.50.

An expedition to Australia for collecting zoological and zootomical specimens for the museum of the University of Christiania and for making anthropological studies of the little known tribes of the region.

Islands

Beebe, C. W. Galapagos. 1924. Putnam, $9.

Scientific research on islands which are still in the age of reptiles.

Evans, I. H. N. Among primitive peoples in Borneo. 1922. Lippincott, $5.

Interesting to students of anthropology.

Johnson, M. E. Cannibal-land. 1922. Houghton, $3.

"Adventures of the author and his wife on the cannibal island of Malekula, one of the New Hebrides, where they went to make a picture record of the natives and their customs." *Book Review Digest.*

Lumholtz, K. S. Through Central Borneo. 1920. 2v. $7.50

An account of two years travel in New Guinea, with ethnological and other scientific discoveries of interest.

The Ocean

Campbell, George. Log-letters from "the Challenger." 1877. Macmillan.

"A diary on board the ship of scientific research "Challenger." Sub-title.

Darwin, C. R. Naturalist's voyage around the world. 1901. Appleton, $2.

Time has not lessened the value of this great book of travels.

Murray, Sir John. Depths of the ocean. 1912. Macmillan, $7.50.

"A general account of the modern science of oceanography based largely on the scientific researches of the Norwegian Steamer Michael Sars in the North Atlantic." Sub-title.

Polar Regions

McLean, J. K. Heroes of the farthest north and farthest south. 1923. Crowell.

Explorers from the earliest times to the present.

Amundsen, R. E. G. The south pole. 1913. 2v. New York, Keedick, $10.

"Remarkable for human interest and spirit of high adventure as well as scientific value." *A. L. A. Catalog.*

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"Straightforward account of the Australasian Antarctic expedition, 1911-14 . . . Scientific and historical summary." *A. L. A. Catalog.*

Scott, R. F. Voyage of the "Discovery." 1907. 2 v. Scribner, $3.

An account, by the commanding officer, of the British National Antarctic Expedition.

SHACKLETON, SIR. E. H. South. 1920. Macmillan, $4.50.

"Author's last expedition, 1914-17. Many exciting experiences in readable style. Appendixes describe scientific accomplishments." *A. L. A. Catalog.*

TAYLOR, GRIFFITH. With Scott. 1916. Dodd, $5.

The account of Scott's ill-fated Antarctic expedition as told by the senior geologist.

TURLEY, CHARLES. Voyages of Captain Scott. 1915. Dodd, $2.50.

"A skilful retelling of Scott's own accounts." *A. L. A. Catalog.*

WILD, FRANK. Shackleton's last voyage. 1923. Stokes, $10.

An account based on the official journal and the private diary of the surgeon of the expedition.

BARTLETT, R. A. and HALE, R. T. Last voyage of the Karluk. 1916. Small, $2.50.

"The captain of the flagship of Stefansson's arctic exploring expedition, 1913-16, tells of heroic adventures on the sinking ship, in the shipwreck camp and on his 200 mile sledge journey to Siberia for help." Horton.

BORUP, GEORGE. A tenderfoot with Peary. 1911. Stokes, $2.10.

A popular and interesting account of the Peary polar expedition.

DE LONG, G. W. Voyage of the Jeanette. 1886. Houghton, $4.50.

Includes a partial record, in the text and in the appendix, of the scientific results of the voyage. More detailed reports are issued by the government.

DOUGLAS, G. M. Lands forlorn. 1914. Putnam, $4.

An account of Arctic exploration into the Barren Grounds of northern Canada. Many illustrations.

GREELY, A. W. True tales of Arctic heroism in the new world. 1912. Scribner, $1.50.

Collection of stories of Arctic expedition adapted to young people.

HENSON, M. A. A Negro explorer at the North Pole. 1912. Stokes.

The author was in Peary's party for twenty years and participated in the last victory of reaching the pole.

MACMILLAN, D. B. Four years in the white north. 1918. Harper, $5.

"Scientific work and grim experiences of the Crocker Land Expedition in northern Greenland. *A. L. A. Catalog.*

MIKKELSEN, EJNOR. Conquering the Arctic ice. 1909. Philadelphia, Jacobs, $3.50.

Recounts the Anglo-American polar expedition of Mr. Mikkelsen and Mr. Leffingwell.

MIKKELSEN, EJNOR. Lost in the Arctic. 1913. Doran, $5.

An account of the three years search of the author for the diaries of the lost expedition of Erichsen.

MUIR, JOHN. Cruise of the Corwin. 1917. Houghton, $3.25.

"Author's daily record on a relief expedition into the Arctic. Geological formation, flora and fauna noted." *A. L. A. Catalog.*

NANSEN, FRIDTJOF. Farthest north. 1904. 2v. Harper, $4.

Record of the voyage of the exploration ship "Fram".

PEARY, R. E. North Pole. 1910. Stokes, $4.80.

PEARY, R. E. Northward over the "great ice." 1898. Stokes, $5.35.

A narrative of the exploration along the shores and upon the interior ice-cap of northern Greenland.

STEFANSSON, VILHJALMAR. The friendly Arctic. 1921. Macmillan, $6.

"Third Arctic expedition, 1913-18. Interesting scientifically and as fascinating adventure." *A. L. A. Catalog.*

STEFANSSON, VILHJALMAR. Hunters of the great North. 1922. Harcourt, Brace, $2.50.

Combines, by the use of diaries, the vivid impressions of the author's early works with the mature knowledge gained through the succeeding ten years experience in the Arctic.

STEFANSSON, VILHJALMAR. My life with the Eskimo. 1913. Macmillan, $6.50.

"Second arctic expedition, 1908-12 . . . Chapter by R. N. Anderson on their natural history collection."

MOTIVATING THE CURRICULUM THRU GEOGRAPHY

OLIVE NOLAN
Dearborn Prevocational School, Boston, Mass.

Motivation within motivation may seem somewhat complicated, but it is always with us. In our prevocational schools we are particularly blessed by having our shop work motivate all our academic work, but in this project, the motivation of all the other studies thru one subject in geography could just as well be carried on in any other school.

Our boys are members of the electrical class, a fact which brings them into close touch with radios, telephones, bells, and all kinds of wiring; but, there is scarcely a person in our country today who is not interested to some degree in all these things. Surely there is not a boy!

One of the most necessary materials for electrical work is copper; so, out of their constant use of copper in the shop, grew our copper project.

Geography

The first subject to be considered was geography and from that, the others, like Topsy, "just grew." A comprehensive survey of the world showed us that copper is mined in twenty countries distributed over the six continents but that our own country is especially rich in that red metal. This was ideal eighth grade review and gave a real reason for an intensive study of the copper regions of the United States. We were most fortunate in having a nugget of copper from the Calumet and Hecla mines and many views of Calumet, Hancock and Houghton, Michigan. As always, these specimens and views were of vital interest to the boys. They were something real—not out of a book. Therefore, we studied the Great Lakes Region first. The pictures of the mines, of the smelters, of the wharves laden with copper awaiting shipment on the lake boats, and of the Soo Canal all brought out discussions and investigations of the mining methods, the refining, the shipment, and the demand for copper.

Where geography ended and the other studies, history and science, for instance, began, it is difficult to tell.

It was impossible to study the Great Lakes Region without realizing that France had played a part in its early history. The ubiquitous French names and the occasional ruin of a French fort spoke of Marquette, Joliet, La Salle and of French traders of a later period. The class admitted a hazy knowledge of these explorers and were glad to refer to history books in geography class time in order to "look them up and get them right." Eagerly, they traced routes and found French names on the maps.

The pictures of the locks of the Soo Canal, with its huge gates, locks, and levers made a fine bit of science for them.

Pictures of the Cobar Copper Works at New South Wales, Australia, showed that in a nearly antipodal land, the people were smelting copper in much the same way as they do in our own land. It might seem that it took seven-league boots to travel from Michigan to Australia but it vivified the work to the boys and brought home to them that "all the world is kin."

Coming back to the copper-laden wharves at Houghton, Michigan, the boys asked, "Why is it shipped away?" Because the demand for it is in New York, Chicago, and other large manufacturing centers. "Why is it not manufactured here?" Because this is a mining and refining region. The copper is mined in nearly pure metallic form, crushed and washed at the mines, refined near by, and then shipped to those centers needing it for their mills and factories. Thus, each section seems to have its own work to do.

A survey of the copper regions of Montana, Arizona and Colorado came next, with emphasis placed on the demand for copper in the Pacific coast states and for Oriental shipment.

Our geographical readers furnished much valuable information about copper smelting and refining. They were interested in comparing Butte, Anaconda, and Tucson with their own and other eastern cities.

We reviewed the copper regions of Canada, Mexico and South America and found those of Europe, Asia, Africa, and Australia. Maps were drawn and colored and trade routes traced in their study, while every day something new came up.

History

Here again, history was so closely allied that we could not escape it and for once, the word tariff really meant something to them. In our study of the copper trade we found that there is no tax on copper imported into the United States so long as it is "fit only for manufacture." Questioning and reading soon brought out the need of tariff—so our history lessons on the origin and development of tariff acts, which was such a vague subject to many of us in our school days, became of live interest to these boys so soon to be men and voters. I believe that they need that knowledge and an understanding of the need of protecting our industries, but only so far as it is just to people of all sections. A little politics? Yes, public affairs.

From copper to Alexander Hamilton surely seems a far cry, but they could not study tariffs without learning much of Alexander Hamilton. Their histories had dealt briefly with this man. His was a master mind, and it was well worth the while of this class to learn how much our government owes of its firm financial standing to Hamilton's keen insight and excellent judgment.

The ever widening difference of opinion between southern planters and northern manufacturers on the tariff question gave them a little clearer conception of the causes of events leading up to the Civil War. The "Tariff of Abominations" and the resultant "Nullification Act" showed very plainly this sectional feeling.

A brief study of the McKinley Tariff, the Wilson Act, and the Dingley Act made very clear to them, the widely diverging opinions of the two large political parties of the United States.

Delving into the uses of copper brought them back again to history, as they found the Statue of Liberty is made of bronze. "What does it represent?" "Who paid for it?" "Why?" were asked. So they reviewed the part the French played in our War of 1776. This led to our part in the World War, so our history came right up to date. The picture of the bronze statue of Abraham Lincoln in Chicago's famous park started a discussion about Lincoln and his influence on our country. The picture of the famous Sacajawa statue in Portland, Oregon emphasized the part the Indians played in the life of the pioneers.

ENGLISH

Our English during this project was decidedly copper colored.

The first need arose when we needed to know whether or not copper had an import tax. The boys wrote to the Custom House officer, asking if there was an import duty on copper. They received a prompt and courteous reply stating that, "Copper fit only for manufacture is free of duty because free copper to develop new industries is considered desirable." It was also stated, that for ten cents, the boys might obtain a copy of the Tariff Acts. Needless to say, they secured a copy of the Tariff Acts and perused it for the first time in their lives.

Later, they wrote to various brass polish companies asking them about the ingredients of their polishes. The replies stated that they could not disclose their formulae. It was a new experience for the boys to receive such a reply and they were daunted for a while. Finally, they decided to find out for themselves and once again their two faithful old friends—the dictionary and the encyclopedia—suggested the answer, i. e., that oxalic acid is the base of most brass polishes. I consider that a valuable experience because it impressed them with the value of those two books.

Their English was not all letter writing. They had oral and written composition on The Uses of Copper; Alloys of Copper; In a Copper Mine; Thru the Soo with a Load of Copper; The Place of Copper among Metals; Qualities of Copper; Copper in the Trades; Copper in the Fine Arts; The First Tariff; Alexander Hamilton; The Statue of Liberty; Copper Thru the Ages; A Copper Miner's Health; Copper in Electrical Work; and many, many more subjects. As some of these were published in the school paper and others used for an exhibit, there was motivation everywhere.

SCIENCE

A few science lessons proved that copper is ductile, malleable, does not rust, is a good conductor, has a lustre, will corrode but can be cleaned with oxalic or acetic acid. Thus, they saw why copper is so valuable to mankind.

SPELLING

The words: ductile, malleable, corrode, and others immediately became words of their spoken and written vocabulary; thus spelling was a necessary tool for science and English.

HYGIENE

Hygiene held its own place in the curriculum. They had lessons on Antidotes for Brass Polish; Prevention of Accidents from Electricity; and Dangers of a Copper Miner.

ARITHMETIC

The stock market news in the papers and on the radio seemed to boom just at that time and such items as "Copper Advances on Fresh Demand for Metal" and "Copper Gains Better than Two Points" gave us an excellent opportunity to turn to work on "Commission" in arithmetic. The tariff work motivated their study of "Duties" in arithmetic and helped make it easy to understand. The actual computation of the amount of copper wire needed for one radio necessitated rapid work in decimals and the use of formulae; while the actual purchasing of radio parts at discount gave them much work in "Discount." We seized this opportunity to review "Percentage" in all forms. All this work was of eighth grade standard so we had not violated a precious

outline. The eternal "Why" had motivated every branch of our work.

Art Appreciation

Geography started all the discussion which so naturally correlated with and motivated the rest of the curriculum. It even impelled us into a study of the Fine Arts. Too often do we forget those finer things in our rush for the more material things of life, but in so doing, the lives of our pupils have lost so much richness. If some appreciation of art is not instilled into these boys in these grades they may never have it. Therefore, it seemed very much worth while to gather as many specimens as possible of beautiful hand wrought things of brass, and to copy designs on old brass shields, bronze vases, etc. The use of copper and bronze by the ancients brought us back again to history and geography.

It seemed impossible to come to a definite stop at any one place, always there was an open door with a "Why" leading us on.

Whys and Other Whys

Why do ships have copper keels?
Why are hot water boilers made of copper?
Why are statues made of bronze?
Why are roof gutters made of copper?
Why do brass faucets turn green?
Why does brass polish remove that green?
Why will vinegar and salt do the same?
Why are tablets made of bronze?
Why were copper tools used before iron ones?
Why is copper wire used for electrical purposes?
Why is brass used for jewelry?
Why has Houghton, Michigan, grown so rapidly?
Why is Japan buying so much copper?
Why is copper used in the arts?
Why is a policeman called a "cop"?

Can you answer all these? We can.

GEOGRAPHICAL PUBLICATIONS

H. L. Shantz and Raphael Zon. **Atlas of American Agriculture. Section E, Natural Vegetation.** 29 pp., 3 maps, 1 diagram, 55 photos. U. S. Department of Agriculture, Washington, D. C. 1924.

This superb piece of work by masters in their field will be welcomed by teachers and students. The vegetation of the United States is discussed under three major groups, viz., forest, grassland, and desert shrub. Teachers of botany or agriculture in agricultural colleges and universities and in normal schools, who will make immediate and material use of the information contained in the publication can obtain a copy, so long as the supply lasts, upon application to Dr. O. E. Baker, Agricultural Economist, U. S. Department of Agriculture, Washington, D. C.

Annals of the Association of American Geographers. A. E. Parkins, George Peabody College for Teachers, Nashville, Tenn. Complete sets, cloth bound, $43.50; paper bound, $37.00.

The Annals contain some of the best articles of the best geographers of America. These publications present the leading thought of the day in the field of scientific geography. They should be in the library of each normal school, college, and university of the country. There are now only seventy-five cloth bound and two hundred paper bound copies available. Requests for copies should be sent direct to Dr. Parkins.

Rose B. Clark. **Unit Studies in Geography.** 249 pp. World Book Co., Yonkers-on-Hudson, New York. 1924. $2.00.

This outline by Miss Clark is one of the best aids for the grade teacher in geography which has come to the notice of the reviewer. Courses of study, outlines for teaching, and method books have been published, but they have barely touched the needs of the great mass of teachers of geography in the grade schools. The thing that the teacher desires, particularly since both the method of treatment (the problem) and the unit of area (the region) is now very generally agreed upon is a variety of lines of procedure and of suggestive material which can be adapted to her particular situation.

The presentation of this book meets this desire. The work is divided into units or topics for which from one to four weeks are required to complete the study. Each unit establishes at the beginning points of contact between the class and the topic to be studied, then develops information concerning it from study of a series of maps, in many cases strives to awaken interest by a suggestive list of interesting facts, and finally turns to the development of the problems covering the unit. Page references to an extensive list of books under each unit practically guarantees that every teacher will find reference materials.

The reviewer would not agree to the assignment of the work to primary, intermediate, and junior high school grades as laid out by Miss Clark. He raises a vigorous protest against the type of work indicated for the junior high school. This does not detract at all from the value of this book, since the last unit of the book—apparently assigned to junior high school pupils—is readily usable in the sixth grade, and only in one or two places is there any indication of the grade for which the work is recommended.

Rhode Island College of Education, Providence ROBERT M. BROWN

R. H. Whitbeck. **Industrial Geography.** 608 pp., 371 maps and photographs, 8 colored maps. American Book Company, N. Y. 1924.

This is a very usable textbook for a high school or college class in commercial geography. The organization is by countries, the various commodities being treated at length in connection with the country which is the chief producer. No attempt is made to offer an exhaustive catalog of the world's commercial products, but rather the more fundamental trends of world trade, and the underlying principles are made clear. The book represents the modern conception of geography as a subject which interprets the activities of man and stimulates logical thought among the students, rather than a subject which accumulates facts to be memorized and promptly forgotten when examinations are over.

After an introductory chapter, the United States is treated in great detail, covering twelve chapters. Canada is given one chapter; Mexico and the Caribbean countries one chapter; and South America two chapters. Nine chapters are then devoted to Europe, including Asiatic Russia. Japan and China are given one chapter each, and of the remaining five chapters, four are devoted to the rest of the world, and the last one to a general summary of the world's producing regions. Few statistics are used in the text, but several pages of statistical material are included in the back for reference. A selected bibliography in which students may find reference material for individual topics is also included, a very welcome addition to the book, especially for schools where the books mentioned can be made available in a library close at hand.

Especially commendable are the maps. Small black and white maps, many of them the familiar and unequalled dot maps prepared under Dr. Baker's direction at the Department of Agriculture, are used to illustrate the text. Seven colored maps of the continents show the relief of the land in pleasing colors, with the political lines in a purple overprint. Railroads are shown in red. The eighth colored map is of the world steamship routes, on which the continents are colored politically. The use of the mercator projection on this world map might be criticised, altho it is of course conventionally acceptable.

Teachers of courses on commercial geography would do well to study this book before choosing their text.

University of Michigan PRESTON E. JAMES

O. J. R. Howarth. **The Mediterranean.** (Certificate Geographies) 175 pages, 63 photos, maps, and diagrams. Oxford University Press, American Branch, N. Y. 1924.

The subject is a splendid one. The lands bordering the Mediterranean belong together as one great region. Yet this book emphasizes that "the Mediterranean Sea separates" three continents, that its "coast line is divided between a large number of different countries," and that being "divided . . . into a number of well-marked physical divisions," it "shows also a number of divisions among its inhabitants, with very different characteristics." Generalizations indicating the unity of the Mediterranean appear here and there—regarding the limestone highlands and steep coasts, the barriers and gateways, the dry subtropical climate, the scrubby vegetation, and the tree cultivation. But these are overwhelmed by the stereotyped enumeration of differences with a deluge of details.

University of Chicago R. S. PLATT